

CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-141

September 27, 1982

1. Name of Fault.

Rodgers Creek.

2. Location.

Sears Point, Petaluma River, Glen Ellen, Cotati and Santa Rosa
7.5-minute quadrangles, Sonoma County (see Figure 1).

3. Purpose of Report.

Part of CDMG's Fault Evaluation Program conducted under the
Alquist-Priolo Special Studies Zones Act (Hart, 1980).

4. References.

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5. Summary of data.

The Rodgers Creek fault was first mapped by Weaver (1949, page 68, plate 1) who recognized its youth ("peculiarities of topography...and sag ponds"). The fault presumably takes its name from Rodgers Creek, which follows the fault for several miles in the Glen Ellen quadrangle. Weaver considered the fault to have normal displacement (down to the east) with no more than 200 feet of offset. He mapped the fault as inferred. He also mapped an inferred southern segment of the Rodgers Creek fault in the Sears Point quadrangle, but considered it to be related to the Tolay fault (Weaver, page 68, plate 13).

Subsequent mapping and seismicity have shown that the Rodgers Creek fault is a more or less continuous active fault zone that extends from the vicinity of Santa Rosa southeastward 25 to 30 miles to the northern margin of San Pablo Bay. The southern end of the fault is concealed, but it may step to the right to connect with the historically active Hayward fault 12 miles to the south (Figure 1). Although the northern end of the Rodgers Creek fault has been considered to be a southern extension of the Healdsburg fault (e.g. Wesson, et al., 1975; Huffman and Armstrong, 1980), the Rodgers Creek fault probably connects complexly with the recently active Maacama fault to the north as suggested by Herd and Helley (1978¹).

As a result of the work of Brown (1970a), Huffman (1971), Armstrong (1974), Fox, et al. (1973), Blake, et al. (1974), Sims, et al. (1973), it became clear

that the Rodgers Creek fault was an important, right-lateral, strike-slip fault. The latter three references relied primarily on the unpublished mapping of Brown (1970b), who identified "recently active" traces of the Rodgers Creek fault. Huffman and Armstrong (1980, pages 17-19; plate 3B, in press in 1975), based on the work of the above authors, identified the potentially active (i.e. Quaternary) traces considered to be hazardous in terms of fault-rupture. As a consequence of these studies, CDMG (1976) established Special Studies Zones (SSZ's) for the Rodgers Creek fault in five quadrangles. The sources of data on which the SSZ's were based are identified on Figures 2a and 2b. The use of Quaternary faults for zoning was consistent with the ^{then} existing zoning policies of CDMG. Since then, CDMG's zoning policies have been revised and are now based on the criteria of "sufficiently active" (Holocene) and "well-defined." These definitions and policies are discussed more fully in Hart (1980, pages 5-6). In addition, whereas the earlier maps were based entirely on the work of others, SSZ maps prepared after 1976 are based, at least in part, on photo interpretations and field verification by program staff.

Although many of the faults of the Rodgers Creek fault zone are clearly of Holocene age, many of the fault strands zoned in 1976 do not appear to be ^{that} recent. Moreover, new information suggests that some of the faults previously zoned are locally mislocated or otherwise do not meet current zoning criteria. In order to evaluate the various interpretations regarding the locations and recency of the different fault strands that comprise the Rodgers Creek fault zone, the most pertinent work is summarized below (more or less chronologically). In addition, an independent study -- based on detailed interpretations of aerial photographs and limited field observations -- was performed by this writer and is summarized on annotated maps (Figure 3a and 3b).

Brown (1970a) published the earliest map identifying recently active traces of the Rodgers Creek and Healdsburg faults. His fault traces are based on the interpretation of 1:80,000 scale air photos and on field checking south of Taylor Mountain (Santa Rosa quadrangle). Because of the small map-scale (1:250,000) and lack of specific supportive data to document his interpretations, Brown's work was not used to compile the Special Studies Zones maps issued by CDMG in 1976. Nonetheless, his work provided an impetus for ensuing work by others.

Brown (1970b) later mapped the Rodgers Creek fault at a 1:24,000 scale, ^{possibly (?)} using larger-scale photos and detailed field mapping from Sears Point to the Santa Rosa area (R.D. Brown, Jr., p.c., 9/16/82). Although Brown's mapping apparently was relied on extensively by Fox, et al. (1973), Blake, et al. (1974), and Sims, et al. (1973), the latter workers either modified and generalized his fault locations or the traces were mislocated in some cases in being transferred to their published maps. Minor mislocations also may have been made by CDMG in preparing the 1976 SSZ maps. Because Brown's (1970b) maps are based on detailed photo and field mapping and are annotated to identify recently active fault traces, it would appear to be the better source of data than Fox, et al., Blake, et al., and Sims, et al. The latter, however, should be additionally cited, because they are published. Brown's unpublished maps are reproduced here as Figures 5a and 5b.

Huffman (1971, plates 5 and 6) mapped a segment of the Rodgers Creek fault in the Cotati and Glen Ellen quadrangles in order to assess the hazard of surface fault-rupture (and other hazards) for the County of Sonoma. His main trace and branch faults A and B were used to compile parts of the Cotati and Glen Ellen SSZ maps (Figure 2a). The two branch faults and segments of the main trace were inferred, although the southern 5-mile segment of the main trace was considered to be "probably active" based on "strong geomorphic and topographic expression"

(trough-like lineaments, deflected drainages, etc.) (Huffman, pages 40-42). North of Copeland Creek, the fault is "inferred to exist beneath landslide and other surficial deposits." Huffman's interpretations north of Lichau Creek contrast strongly with the traces mapped by Fox, et al. (1973; Figure 2a), suggesting that the fault is difficult to identify as a recent surface feature in this area.

Armstrong (1974) mapped potentially active (i.e. Quaternary) traces of the Rodgers Creek fault to the south of Huffman⁽¹⁹⁷¹⁾ in the Glen Ellen, Petaluma River, and Sears Point quadrangles. His annotated maps (1:24,000 scale) were based mainly on aerial photo interpretations and limited field checking (Armstrong, p.c., 9/24/82). Armstrong interprets the Rodgers Creek fault zone to be as much as 3,500 feet wide. Although some of his fault traces coincide with Fox, et al. (1973), Blake, et al. (1974) and Sims, et al. (1974), most do not (see Figure 2a). Many of the fault features interpreted by Armstrong appear to be erosional or are suggestive of recent landsliding (e.g. see Figure 3a). Armstrong, et al. (1978), is very similar to Armstrong's 1974 unpublished data, although a brief text and logs of the road cuts along Stage Gulch Road have been added. The faults shown to offset soil and alluvial units in road cuts in the 1978 report (pages 79-83) could not be verified by this writer. Although most of Armstrong's (1974) traces were used on the 1976 SSZ maps of the Glen Ellen, Petaluma River, and Sears Point quadrangles, he does not provide information on the relative recency of the many traces and it is difficult to interpret which fault strands are Holocene -- a determination that would be necessary if the SSZ maps were revised.

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Fox, et al. (1973), Blake, et al. (1974), and Sims, et al. (197³), all published 1:62,500 scale maps showing "recently active" traces of the Rodgers Creek fault based on unpublished, annotated maps of Brown (1970b). These traces were used in compiling the zone maps reproduced in Figures 2a and 2b. Minor

plotting errors may have been introduced in transferring the data from one map to another. Several additional faults (identified as E, F, H, I on Figure 2a and K on Figure 2b) are not identified as recently active by Fox, et al., Blake, et al., and Sims, et al., also were shown on the SSZ maps. Except at the south end of the fault zone (Figure 2b), none of the faults identified as recently active are shown to clearly offset Holocene alluvium, although a number of faults offset older alluvium and landslide deposits.

Huffman and Armstrong (1980, but in press in 1975) compiled a 1:62,500 map (their Plate 3B) showing the various strands of the Rodgers Creek and Healdsburg faults as "potentially active" (Quaternary). With one or two minor exceptions, all of the traces shown were based on the work of Huffman (1971), Fox, et al. (1973), Armstrong (1974), Blake, et al. (1974), and Sims, et al. (197³~~4~~). Included in the group of "potentially active" faults were the "recently active" faults, as well as several other faults, of the other cited works. Because of the Quaternary zoning criteria used by CDMG in 1975, all of the potentially active faults of Huffman and Armstrong were used to compile the SSZ maps (Figures 2a and b). However, the original works were used in order to avoid possible plotting errors. Despite the Quaternary classification, Huffman and Armstrong (page 19) recognized the Rodgers Creek fault as Holocene active based on "highly distinctive fault-related topographic features" and a "coincidence of earthquake epicenters." The southern part of the Healdsburg fault (i.e. the Rodgers Creek fault north of Santa Rosa) was considered to be connected to the Rodgers Creek fault south of Santa Rosa and to be the source of the October 1, 1969 earthquakes (Huffman and Armstrong, page 17). Although no ground rupture was reported, the aftershock zone coincides rather well with the Rodgers Creek-Healdsburg fault (Steinbrugge, et al., 1970, Figure 68).

Herd (1978) mapped the southern part of the Rodgers Creek fault, showing it as

a wide (one to three miles) complex zone of short, discontinuous traces. His annotated maps are based largely on the interpretations of air photos. Only the main trace south of Stage Gulch Road is shown to be narrow and well defined. This trace corresponds closely to traces mapped by this writer (Figure 3^a) and by Brown (1970b). According to Herd (p.c., 9/14/82), a trench excavated in 1975 by the U.S.G.S. revealed that all soil and alluvial units exposed near a sag pond were faulted at a locality 0.5 mile NW of Wildcat Mountain. This clearly indicates Holocene movement. Northwest of Stage Gulch Road, Herd shows the Rodgers Creek fault to be largely obscured by massive landslides and no fault

trace is shown northwest of Petaluma Reservoir in the Glen Ellen quadrangle. Another discontinuous fault of Herd (1978) is shown 1 to 1.5 miles to the northeast at the base of the eastern slope of the Sonoma Mountains (Figure 2a). No evidence is provided that would indicate Holocene faulting here, although a "NE facing 'ramp/scarp' in alluvial fan with springs along the face of the scarp" may suggest late Quaternary displacement. A similar fault is mapped by Huffman and Armstrong (1980, plate 3B), who also classify it as Quaternary but provide no evidence of Holocene slip. Except for the latter trace, none of the traces of Herd are plotted in this report. According to Herd (p.c., 9/14/82), the work of Herd (1978) has been significantly revised to show only well-defined traces of the Rodgers Creek fault zone. Unfortunately this revision will be published only on a small-scale map and without annotations.

Herd and Helley (1977) and Helley and Herd (1977) have mapped the Rodgers Creek fault at a scale of 1:125,000 showing it to be a complex zone extending discontinuously from Sears Point to Santa Rosa (see Figure 4). The Helley and Herd reference is similar to Herd (1978). Unpublished 1:24,000 scale maps of Herd (1982) are different from Herd and Helley, showing no faults south of Taylor

Mountain (Santa Rosa quadrangle). Other changes also are being made by Herd (1982), but his fault traces are not annotated.

Jennings (1970) also mapped segments of the Rodgers Creek fault in his unpublished work in the northeastern portion of the Santa Rosa quadrangle. The Rodgers Creek fault is shown to be a 1.3-mile wide, complex zone north of Santa Rosa and a narrow zone to the south. Although not directed at the problem of recent faulting, Jennings' map clearly shows major lithologic truncations both north and south of Santa Rosa that coincide with recent fault interpretations of this writer (Figure 3b).

Cebull (1958) mapped a southern segment of the Rodgers Creek fault in the Sears Point quadrangle, citing its youthful features and showing 2.5 miles of apparent right-lateral slip. However, he mislocated the fault in places and his data is not useful for zoning purposes.

Ford (1975) evaluated the groundwater basins in Sonoma County. His cross-section C-C' (pages 28-29) shows the Rodgers Creek-Healdsburg fault in bedrock but does not indicate that it offsets the overlying alluvial units or forms a groundwater barrier.

Pampeyan (1979) compiled a small-scale map of the north coastal region, classifying the Rodgers Creek-Healdsburg fault as Holocene throughout the length of the study area.

Chapman, et al. (1982), conducted detailed gravity studies in Santa Rosa which suggest an approximate location for the concealed trace of the Rodgers Creek fault in the alluvial area between State Highway 12 and the County Hospital (Figure 3b).

As a result of the Alquist-Priolo Act and establishment of Special Studies Zones, a number of sites have been specifically investigated by consulting geologists to locate and evaluate the traces of the Rodgers Creek fault in the Santa

Rosa and Cotati quadrangles. Most of these investigators have done exploratory trenching and reports have been filed with CDMG. Some of the reports provide direct observations regarding the presence or absence of faults and evidence of fault recency although other investigations appear inconclusive. The trench log data are summarized in Table 1 and the trench locations and "active" faults identified are plotted on Figures 2a and 2b. This writer does not agree with all of the interpretations made and believes that several of the active faults identified are related to recent landslides, some of which are very large.

6. Seismicity.

Epicerter data of Real, et al. (1978), show that well-located earthquakes (A quality) are closely associated with the Rodgers Creek fault. However, these epicenters are sparse prior to 1975 because of the lack of adequate instrumentation. More recent data for the study area could not be obtained in time for this report, but it is believed that all segments of the Rodgers Creek fault will be shown to be seismically active. High-quality hypocentral data show the north-northwest extension of the Rodgers Creek fault (including the southern segment of the Healdsburg fault) to be seismically active (Marks and Bufe, 1978). However, the seismic zone is dispersed east of Healdsburg and appears to connect complexly with the Maacama fault. The 1969 Santa Rosa earthquakes almost certainly were along the Rodgers Creek-Healdsburg fault and the aftershock zone aligns well with the fault trend (Steinbrugg^e, et al., 1970, Figure 68). Other damaging earthquakes also may have been caused by the Rodgers Creek fault (e.g. Topozada, et al., 1981, pages 89, 116, 122, 130).

7. Aerial Photographic Interpretations; Field Checking.

Detailed stereographic interpretations were made by this writer during August

and September 1982 of USDA (1952-1953), U.S.G.S. (1970; 1973-1974), CDMG (1976), and Sonoma County (1971) photos to identify recent geomorphic and other features indicative of Holocene faulting. In addition, several segments of the Rodgers Creek fault were field checked and previous observations of trenches north and south of Santa Rosa were made in 1978 and 1979. These data are plotted on Figures 3a and 3b along with pertinent annotations. An effort was made to identify the most active and well-defined traces. The principal observations are summarized below.

1. The Rodgers Creek fault is best defined by recent geomorphic features (linear troughs, drainages and benches; closed depressions; right-laterally deflected drainages; associated tonal features) along four segments: Petaluma River and Sears Point quadrangles; Rodgers ^{Creek} to Sonoma Mountain Road (Glen Ellen quadrangle); Taylor Mountain to Matanzas Creek (southern Santa Rosa quadrangle); and north of Chanate Road (northern Santa Rosa quadrangle). These segments are highlighted in yellow on Figures 3a and 3b. Each of the segments show good evidence of recent and systematic right-lateral slip.
2. There are major right step-overs between the well-defined segments where active traces of the fault are partially to totally obscured by massive landslides (southern two step-overs) or alluvium (Santa Rosa area). Massive landsliding and lateral spreading also partially obscure other segments locally.
3. Judging from the development of recent geomorphic features along the better-defined segments of the Rodgers Creek fault (in comparison with other strike-slip faults studied), it is estimated

- that the rate of recent slip is on the order of 1 to 4 millimeters per year. When viewed in the context of the well-defined geomorphic features suggestive of gravity-induced landsliding and lateral spreading (especially between Taylor Mountain and Petaluma Reservoir), there is little wonder that some segments of the Rodgers Creek fault are poorly defined and lack features diagnostic of recent faulting. Indeed, it may be that active faulting is at an insufficient rate to propagate upward through the recently active surficial units or is distributed in some manner. Some of the landslide and lateral-spread features are shown on Figures 3a and 3b. That widespread downslope movements are still occurring has been verified in the field in several areas. Additionally, soil-filled fissures and other pull-apart features are very evident in trenches and road cuts. Some of the "active faults" identified by others on the basis of offset soils and soil-filled fissures are believed to be caused by minor downhill movements along faults (not necessarily active), joints and weak beds (Table 1; Figure 2a and b).
4. Although the fault is seismically active, surface faulting has not been reported anywhere in the study area, with one possible exception. The exception is a fence (10 to 20? years old) that is offset 2 to 4 inches right-laterally where it crosses the main active fault north of Stage Gulch Road. However, expansive soils, landsliding or initial construction may be the cause of this apparent offset in view of the absence of other supportive evidence.

8. Conclusions

Based on the data presented, the following conclusions may be drawn for the Rodgers Creek fault in the study area:

- a. The fault is an important, through-going structure that truncates late Cenozoic units and geologic structures along its entire length. Geologic evidence indicates that recent displacement has been in a right-lateral sense.
- b. Four segments of the fault are well-defined at the surface by an alignment of linear troughs, closed depressions, right-laterally deflected drainages and other features indicative of systematic Holocene displacement. Several trenches verify Holocene faulting along three of the four segments. The four segments are shown on Figures 3a and 3b.
- c. Historic seismicity is associated with the fault, although evidence of historic surface rupture is generally lacking.
- d. The fault is partly to totally concealed by massive landslides or alluvium between the four well-defined segments.
- e. The fault, including all strands considered to be Quaternary in age, were previously zoned for Special Studies in 1976 (Figures 2a and 2b). In some cases, the faults are mislocated or do not appear to be Holocene-active. The existing SSZ's are unnecessarily wide in some places or encompass faults that are not Holocene active or well defined (e.g., Faults A, C, D, E, F, G, H, I, K on Figures 2a and 2b).

9. Recommendations

It is recommended that the 1976 SSZ maps of the Santa Rosa, Cotati, Glen

Ellen, Petaluma River and Sears Point quadrangles be revised to show only those faults that are well-defined, Holocene features, in line with current policies of CDMG. This revision should rely basically on the interpretations of this writer (mainly the traces highlighted in yellow on Figures 3a and 3b), plus the main traces of Brown (1970^b) and Huffman (1971). Since Brown's work is not published, but was used by Fox, et al. (1973), Blake, et al. (1974), and Sims, et al. (1973), the latter references also should be cited. Armstrong (1978) and Herd (1978) may be cited as confirming references (i.e. their work tends to confirm the main traces of Brown, Huffman, and this writer, although Armstrong and Herd show numerous traces that either do not represent Holocene faults or are related to landslide features).

10. Report prepared by: Earl W. Hart
September 27, 1982

Earl W. Hart

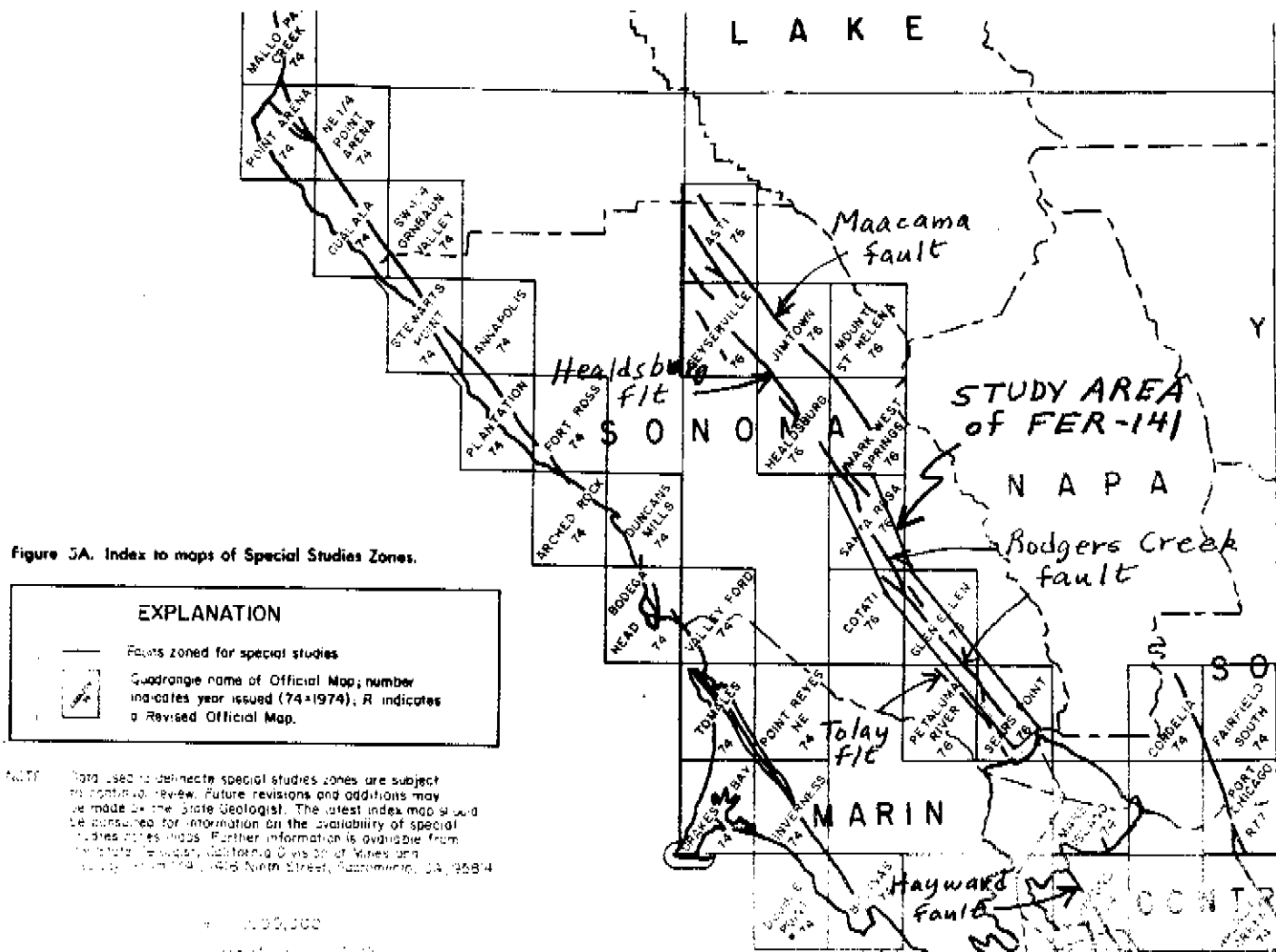


Figure 1 (FER-141). Locations map showing Rodgers Creek and other faults zoned for special studies (Hart, 1980) and study area of FER-141.

Table 1. Unpublished fault-investigation reports with trench data, Santa Rosa quadrangle.

CDMG file #	Investigation firm (or geologist)	Site description and locality	Date of report(s)	Comments
AP 182	Harding-Lawson	Buena Vista Sub. No. 2, Santa Rosa	1/30/76	Shallow trenches and sidehill excavations to 70' long. No active faults, but small fissures and clay-filled joints that trend N to NE found in SS. Minor downhill movement indicated.
AP 201	Cooper-Clark	Proposed medical center for Chanate Corp.	3/1/76	Two long and two short trenches exposed NW-trending fault with steep dip to E. Soil offset up to 1.5' (down to NE) in all trenches.
AP 243	Moore and Taber	Bennett Valley Rd. & Farmers Lane (Mann parcel), Santa Rosa	8/22/75	230' long trench; no fault found. Topsoil not offset, but beds dip steeply. Location approximate.
AP 508	T.D. Hayes	SW corner 4th and Talbot, office bldg., Santa Rosa	6/14/77	120' trench in alluvium; no fault reported.
AP 516	T.D. Hayes	Medical office bldg., 1111 Sonoma Ave., Santa Rosa	7/29/77	186' trench, 14' deep in alluvium; no fault reported.
AP 799	Cooper-Clark	Medical Center (Shroeder), Doyle Park Drive, S.R.	6/5/78	215' trench, 25' trench. Fault reportedly offsets alluvium and topsoil(?) 8-10". However, lower beds not offset below silty sand. Probably a lateral-spread feature related to liquefaction.
AP 800	Harding-Lawson	Cobblestone project, north Santa Rosa	7/6/78	260' long trench in agglomerate & tuff breccia. No faults found, but numerous clay-filled fissures (suggestive of distributive downslope movement).

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Table 1 (cont.) Unpublished fault-investigation reports with trench data, Santa Rosa quadrangle.

GDMG file #	Investigation firm (or geologist)	Site description and locality	Date of report(s)	Comments
AP 1010	Dames and Moore	5-acre parcel N of Mt. Olive Dr. (Pedrazzini), Santa Rosa.	7/10/79	Six deep trenches to 250' long. N 45 degrees W-trending, NE-dipping fault in Pleistocene alluvium; does not offset soil(?). Main trace in linear depression to E of trenches.
AP 1199	Earth Science Consultants	Lots 1 & 3, Ramona Dr., Santa Rosa.	2/28/78	Two short trenches in alluvium. No faults reported.
AP 1231	Herzog & Associates	1604 Fourth St., Santa Rosa.	9/30/80	Two short trenches in alluvium; no fault reported.
AP 1385	Harding-Lawson	TMI Property, Fountain Grove Ranch, north Santa Rosa.	5/12/80	Numerous trenches to 300' long, 5,000' total; mostly short and shallow. Holocene faults identified or inferred based on soil offsets (mostly minor), clay-filled fissures, bedrock faults, and photo-interpretations. Fault locations used to establish building setback zones shown on Fig. 2b. Because of distance between trenches, short trenches, and evidence of large-scale sliding, some interpretations re fault recency & continuity appear inconclusive. "Perpendicular" (dip-slip?) slickensides reported in numerous places indicate complex down-slope movement (vs. right slip). Text does not provide specific rationale for connecting individual faults between trenches. Sense of displacement on separate faults not indicated; evidence for systematic offsets lacking.
AP 1407	Earth Systems Consultants	Oakridge Development, Santa Rosa.	7/10/80 & 1/8/81	Main trace of active Rodgers Creek fault identified in two trenches 5-8' deep. Topsoils offset in both.

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Table 1 (cont.) Unpublished fault-investigation reports with trench data, Santa Rosa quadrangle.

CDMG file #	Investiation firm (or geologist)	Site description and locality	Date of report(s)	Comments
AP 1426	Herzog & Associates	1635 Terrace Way, Santa Rosa.	8/11/81	Three trenches totalling 163' long x 10' deep. Sheared bedrock and deformed alluvium & col-luvium exposed; setback recommended along E-W zone(??)
AP 1427	Hays & Associates	Elderly Housing, Chanate Road, Santa Rosa.	10/7/81	240' long x 5' deep trench oriented N-S. No faults. Beds strike N 30 degrees W, dip 65-70 degrees NE.
AP 1432	Moore & Taber	Apartment site, Mt. Olive Dr., Santa Rosa.	1/18/79	Long trench exposed faults in SS -- gravel-clay units; strike N 50-80 degrees W, steep dips; top-soil unit thickens but is not offset over fault.
H-0071	Dames & Moore		10/26/76, 10/30/76	630' of 15' deep trenching in alluvium; no faults found. Gravity and seismic refraction surveys suggest anomalous zone to E of site (data based partly on CDMG work); inconclusive.
C-506	Cooper-Clark	1970 Addition to Main Wing, Sonoma Community Hospital, Santa Rosa.	4/25/78	8 trenches to 350' long x 10' deep expose nu-merous faults, some of which disturb or offset soil units. Principal fault trends N 15-20 de-grees W and is 40-50' wide. Another fault zone lies 100' to W.
C-508	Hays & Associates	Residential site APN 049-450-09 (south of Santa Rosa).	10/18/77	180' trench exposes steeply-dipping volcanic and sedimentary rocks with "clay seams". No fault report (speculated to lie in swale to east), but vertical contacts, shears, & clay seams suggest fault where shown on SSZ map. Lack of topsoil prevents analysis of recency.

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Table 1 (cont). Unpublished fault-investigation reports with trench data, Cotati quadrangle.

CDMG file #	Investigation firm (or geologist)	Site description and locality	Date of report(s)	Comments
AP-1409	Herzog & Associates	Snyder Lane at Baumgardner Lane, Rohnert Park	11/10/78	870' of trenches 10' deep in alluvium. No fault reported, but beds at NE end appear disturbed (by landsliding?)
C-509	Earth Science Consultants	Lot 4, Alta Monte Dr. (AP 49-460-05)	6/23/77	105' long, shallow trench in Sonoma Volcanics & SS; no fault reported.
C-510	Herzog & Associates	Lots 12 & 13, Block 49, Alta Monte Estates.	3/9/76	Road cut on N side of Alta Monte Dr. exposes Sonoma volcanics with "silt-filled notches" (= soil filled fractures) attributed to "sympathetic faulting". However, it would appear that these are tensional fractures related to landsliding.
C-513	Purcell, Rhoades & Associates	Crane Cyn Rd. horse barn.	12/17/79	5 trenches to 280' long x 10' deep. Fault interpreted to trend E-W, but not documented in logs, which show faults, shears and deformed units (Petaluma Formation, soils) of various orientations. Deformation partly plastic, probably due to sliding.
C-514	Moore & Taber	AP 49-10-81, NE $\frac{1}{4}$, NE $\frac{1}{4}$, NW $\frac{1}{4}$ sec. 21, T 6 N, R 7 W.	2/2/79	90' trench, shallow, in Petaluma Formation. 2 clay seams interpreted as sympathetic faults; inconclusive <u>re</u> activity. Rocks highly expansive.
C-515	Kleinfelder & Assoc.	Minor Sub. 6863.	10/18/79	140' trench exposed several faults of various orientations in Sonoma Volcanics; soil offset. Probably landsliding, but active faults interpreted by consultant based on air photos and trenching. Site is hummocky; landslides reported nearby.

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